



Information Technology Infrastructure And Sustainability Of Virtual Organizations In Port Harcourt, Rivers State

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Abstract

The purpose of the study was to unravel the relationship between information technology infrastructure and sustainability of virtual organizations in Port Harcourt, Rivers state. The study population was made up of leaders of functional and operational virtual organizations in Port Harcourt. The study argued that application, network, database, and warehouse enhance the sustainability of virtual organizations in Port Harcourt. Primary data was collected using structured questionnaires from one hundred and thirty-six (136) leaders who were conveniently selected from regional offices and branches of the 12 functional and operational virtual organizations in Port Harcourt, Rivers State. Data was analyzed using the Spearman Rank Order of Correlation Coefficient with the help of SPSS version 23.00. The study found out that there is a positive and significant relationship between information technology infrastructure and sustainability. From the findings made, the study therefore, recommends that; the leadership of virtual organizations should adopt the tested attributes of information technology infrastructure so as to drive the sustainability of virtual organizations in Port Harcourt.

Introduction

Information technology (IT) infrastructure and sustainability of virtual organizations typically delves into the intersection of technology, organizational structure, and environmental concerns. One notable study by Stankovic et al. (2018) explored the relationship between IT infrastructure and sustainability in virtual organizations. The authors emphasized the importance of robust digital infrastructure, including network systems and cyber security measures, in supporting the sustainability goals of virtual organizations.

The business landscape of today requires new and innovated applications in the areas of marketing, manufacturing, and customer service to meet growing customers' demands. As organizations strive for competitive advantages with their applications, the concepts of "time to market" and "flexibility" has become significant attributes. This new business

environment has produced concepts such as campaign management systems (CMS) for marketing, supply chain management (SCM) for manufacturing, and customer relationship management (CRM) for customer service. CMS may be viewed as a marketing system that assists in the planning, product/service definition, scheduling, and execution of a marketing campaign. SCM is often viewed as the support system to aid manufacturing in the efficient production and delivery of goods. CRM can be defined as a technological mechanism used to enhance the customer's relationship with an organization. While all of these relatively new managerial system tools are technologically based, they seem to have a single inherent quality, that of flexibility. That flexibility is believed to be the basis of a competitive advantage. But the concept of flexibility that many of these applications are built upon is not new, and actually evolved from old concepts.

Gupta, et al. (2022) examines the impact of emerging technologies such as blockchain and IoT on the sustainability of virtual organizations, exploring how these innovations can improve transparency, efficiency, and environmental performance. Research on the information technology (IT) infrastructure and sustainability of virtual organizations has gained significant attention in recent years. Virtual

organizations, defined as entities that operate primarily through digital platforms and remote collaboration, rely heavily on IT infrastructure to sustain their operations and achieve long-term viability. According to David (1996), a virtual organization is a network of independent entities, often geographically dispersed, that collaborate via electronic means to achieve common goals. The competitive, global nature of business and the

development of robust telecommunication network technology have led organizations to design new business processes for organizing work to maintain a competitive advantage. Specifically, organizations have begun using virtual teams as a solution to optimizing dispersed resources. Virtual teams are geographically dispersed groups of people linked together by a common purpose and advanced computer and telecommunication technologies. This organizational design provides optimum teaming of world-class competencies by linking together employees who might not otherwise be available to work together. Similarly, Hilty et al. (2019) conducted research on the environmental sustainability aspect of IT infrastructure in virtual organizations. They highlighted the potential environmental impacts of digital technologies and proposed strategies for reducing carbon footprints through efficient IT management practices.

Furthermore, Kagermann et al. (2019) examined the role of IT infrastructure in enabling agile and resilient virtual organizations. They emphasized the need for flexible IT systems that can adapt to changing business environments while maintaining sustainability goals. Overall, these studies underscore the critical role of IT infrastructure in supporting the sustainability and resilience of virtual organizations in Port Harcourt, providing valuable insights for practitioners and policymakers alike. These studies collectively contribute to understanding how IT infrastructure can support the sustainability objectives of virtual organizations in Port Harcourt, providing insights into technological innovations, management strategies, and environmental considerations.

Statement of the problem

Information technology (IT) infrastructure and sustainability of virtual organizations typically addresses the challenges and gaps in achieving sustainable operations within virtual settings. In the context of virtual organizations, there is a pressing need to understand and address the intricate interplay between information technology infrastructure and sustainability. Despite the significant advantages of digital operations, virtual organizations face challenges in ensuring the long-term sustainability of their IT infrastructure. The current lack of comprehensive frameworks and strategies tailored to the unique requirements of virtual organizations hinders their ability to effectively manage and mitigate these challenges, potentially impeding their sustainability objectives. Another challenge is ensuring a reliable internet connection. Since virtual organizations heavily rely on the internet for communication and collaboration, any disruptions in connectivity can impact productivity. Another challenge is managing cybersecurity risks. Virtual organizations need to stay vigilant and implement robust security measures to protect sensitive data and prevent cyber attacks. Additionally, keeping up with technological advancements and regularly updating software and hardware can be a challenge. It requires staying informed and adapting to new technologies to ensure the IT infrastructure remains efficient and effective. Thus, there is an urgent need for research and practical solutions that bridge the gap between IT infrastructure and sustainability in virtual organizations, enabling them to optimize resource utilization, enhance resilience, and minimize environmental footprints while maintaining operational efficiency and competitiveness in the digital era.

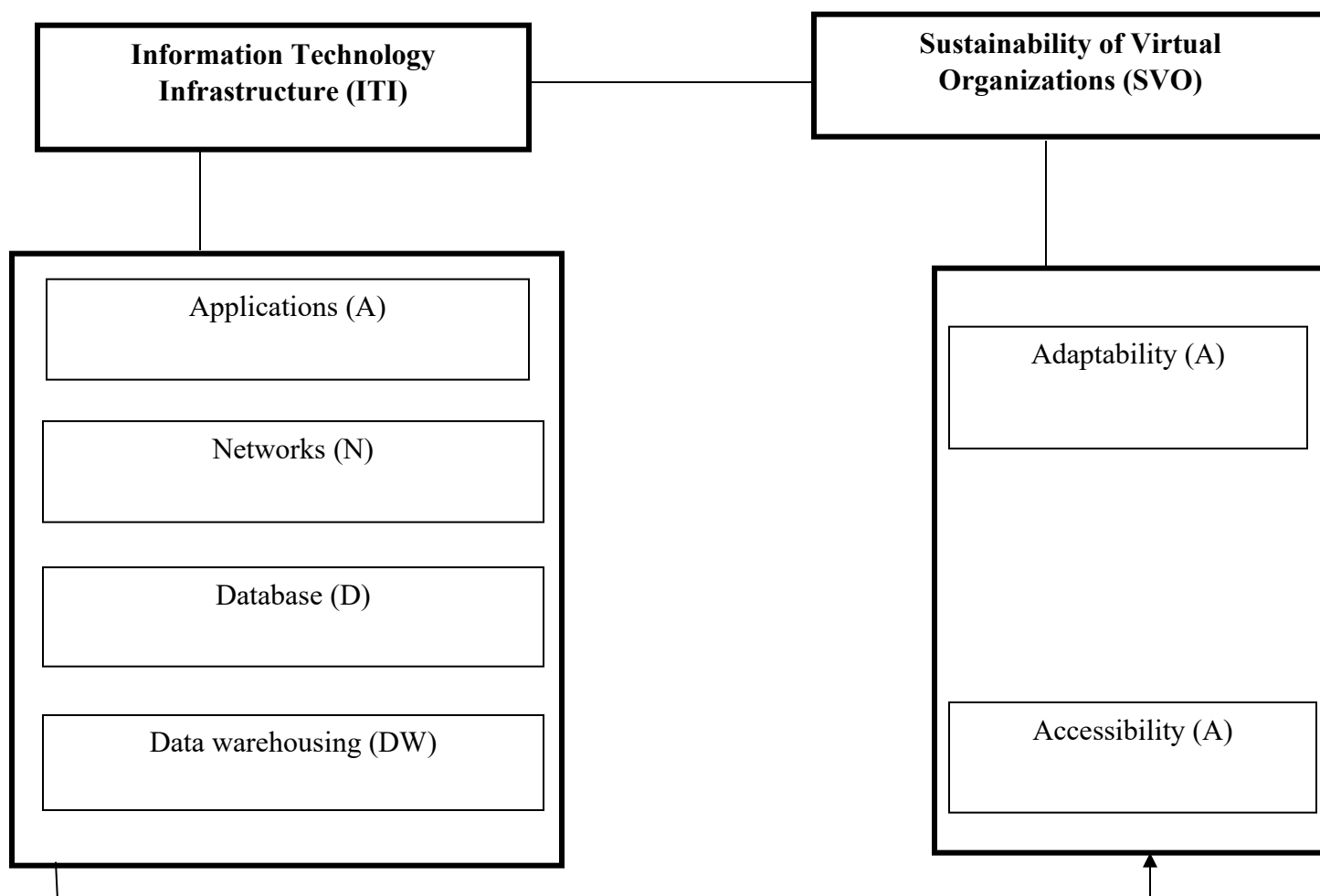


Fig. 1.1: Conceptual Framework of Information Technology Infrastructure and Sustainability of Virtual Organizations

Source: Researchers' Conceptualization from the Review of Related Literature 2024

Purpose of the study

The general purpose of this study was to examine the relationship between information technology infrastructure and sustainability of virtual organizations in Port Harcourt. The specific purpose of studying information technology infrastructure and sustainability of virtual organizations, include:

- a) To examine how applications enhances the sustainability of virtual organizations in Port Harcourt.
- b) To evaluate how networks facilitates the sustainability of virtual organizations in Port Harcourt.
- c) To investigate how database enhance the sustainability of virtual organizations in Port Harcourt.

- d) To analyze how data warehousing enhance the sustainability of virtual organizations in Port Harcourt.

Research Questions

The following research questions were posed to guide this study are stated as follows:

1. To what extent do applications enhance the sustainability of virtual organizations in Port Harcourt?
2. How does network enhance the sustainability of virtual organizations in Port Harcourt?
3. How does database enhance the sustainability of virtual organizations in Port Harcourt?
4. To what extent does data warehousing enhance the sustainability of virtual organizations in Port Harcourt?

Research Hypothesis

The null hypotheses formulated to guide this study are stated as follows:

H₀₁: There is no significant relationship between applications and adaptability of virtual organizations in Port Harcourt.

H₀₂: There is no significant relationship between applications and accessibility of virtual organizations in Port Harcourt.

H₀₃: There is no significant relationship between network and adaptability of virtual organizations in Port Harcourt.

H₀₄: There is no significant relationship between network and accessibility of virtual organizations in Port Harcourt.

H₀₅: There is no significant relationship between database and adaptability of virtual organizations in Port Harcourt.

H₀₆: There is no significant relationship between database and accessibility of virtual organizations in Port Harcourt.

H₀₇: There is no significant relationship between data warehousing and adaptability of virtual organizations in Port Harcourt.

H₀₈: There is no significant relationship between data warehousing and accessibility of virtual organizations in Port Harcourt.

Significance of the study

The first beneficiaries of this study would be the virtual organizations operating in Port Harcourt, as the study is specifically domiciled in their sector, as a result, at the completion of the study, it is expected that valuable insights will be derived from this study by virtual organizations that will be integral to overall sustainability. Employers of labour and organizational leaders in other sectors will also benefit immensely from the findings of this study, it is expected that superiors will eventually realize the positives that comes with the deployment of information technology infrastructure as it is not only cost effective but also integral to organizational productivity. Government ministries and other public agencies will also benefit enormously from this study such that, superiors in respective agencies will also gain valuable insights from this study as far as information technology infrastructure. Academics and other researchers would also find this study very rewarding as the study

would be used as reference material. Students and future researchers especially those in office and information management will find this research very useful since it will serve as a guide for future researches in the field of office and information management.

Scope of the study

Content Scope: This study focuses on ascertaining the relationship between information technology infrastructure and the sustainability of virtual organizations in Port Harcourt. It covers concepts such as; Applications, Network, Database and Data warehousing are adopted as the dimensions of information technology infrastructure while Adaptability and accessibility are adopted as the measures of sustainability of virtual organizations.

Geographical Scope: This study will embrace virtual organizations in Port Harcourt.

Unit of Analysis: The macro unit of analysis will be adopted. This is because; the leadership of virtual organizations will constitute our target population.

Limitations of the study

This study comes with its own set of challenges and difficulties. Obtaining accurate and comprehensive data from virtual organizations was difficult due to privacy concerns because the researcher must navigate ethical considerations related to data privacy, confidentiality, and informed consent, especially when studying virtual teams or individuals who may be geographically dispersed. Also, finding a sufficient number of virtual organizations willing to participate in research studies was challenging since the researcher requires access to specific industries or types of virtual organizations. The epileptic power supply in the researcher's residential environment greatly affected the work. Finally, the researcher is restricted only to the available information provided by the participants in the research and cannot determine the reliability and correctness of the information provided.

Definition of Terms

The key terms used in this study are systematically highlighted and defined as follows:

Accessibility: This refers to the extent to which something, such as a product, service, environment, or information, is available and usable by people with disabilities or other diverse needs. It ensures that everyone, regardless of abilities or limitations, can participate fully and equally in activities, use facilities, and access information.

Adaptability: This is the ability to adjust or change in response to new conditions, situations, or environments. It involves being flexible, resilient, and able to learn and grow in different circumstances.

Applications: Applications, often referred to as "apps," are software programs designed to perform specific tasks or functions on computers, smart phones, tablets, or other digital devices. They are developed to meet the needs and preferences of users. Applications can be downloaded and installed from various sources, such as app stores, websites, or pre-installed on devices.

Database: This is a structured collection of data organized for efficient retrieval, storage, and manipulation.

Data warehousing: Data warehousing is the process of collecting, storing, and managing large volumes of structured and unstructured data from various sources within an organization. This data is consolidated into a centralized repository, known as a data warehouse.

Information Technology Infrastructure: Information Technology (IT) infrastructure refers to the combination of hardware, software, networks, facilities, and services required for the existence, operation, and management of an organization's IT environment.

Networks: A network is a interconnected system of nodes or entities that communicate and share resources with each other. These nodes can be computers, servers, devices, or even people. Networks can be local, connecting devices within a limited area like a home or office, or wide-reaching, such as the internet, which connects devices globally.

Sustainability: This refers to the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs. It involves balancing economic, environmental, and social considerations to ensure long-term viability and resilience in resource usage, development, and societal well-being.

Virtual organizations: Virtual organizations are entities that operate primarily or entirely through digital means, without a central physical location. They leverage technology to facilitate communication, collaboration, and coordination among geographically dispersed members or teams.

Review of Related Literature

This chapter will discuss the study variables and its underpinning dimensions and measures. Therefore, the following will be discussed under this section.

- a) Theoretical Foundation
- b) Overview of Information Technology Infrastructure
- c) Understanding Information Technology Infrastructure
- a. Applications
- b. Network
- c. Database
- d. Data Warehousing
- d) Sustainability
- a) Adaptability
- b) Accessibility
- c) Resource Based Theory

The baseline theory associated with this study is the resource-based theory (RBT). The resource based theory is an influential approach in strategic management. It has been widely applied as a managerial framework to determine vital resources for a firm to achieve a sustained competitive advantage. The theory provides an essential framework to explain and predict the fundamentals of a company's performance and competitive advantage. Resource-Based Theory (RBT) was first put forward by Penrose (2009), who proposed a model on the effective management of firms' resources, diversification strategy, and productive opportunities. Penrose's publication was the first to propose conceptualising a firm as a coordinated bundle of resources to address and tackle how it can achieve its goals and strategic behaviour (Penrose, 2009). RBT began to take shape in the 1980s. The antecedent of RBT was the Theory of the Growth of the Firm. Later, during the 1990s, Jay Barney's work was critical to the emergence of RBT and became the dominant paradigm in strategic management and strategic planning. RBT provides a framework to highlight and predict the fundamentals of organisation performance and competitive advantage. The focus of RBT on the firm's performance based on Meso's perspectives was a reaction to the earlier managerial interest in the industry structure, a more macro perspective. RBT addresses an internally-driven approach by focusing on internal organisation resources, as opposed to externally driven approaches to understanding the accomplishment or failure of leveraging organisational activities (Kozlenkova, Samaha & Palmatier, 2014). It aims to elaborate on imperfectly imitable firm resources that could potentially become the source of sustained competitive advantage (Barney, 1991).

Overview of Information Technology Infrastructure

In increasingly competitive business environment, information technology (IT) infrastructure is the most important aspect of all aspects of human life,

including business activities where companies are required to keep up their developments in information technology so that they can improve their performance. This is following the research results of (Mithas & Rust, 2016) which stated that information technology has an effect on company performance in reducing costs and increasing revenue. The concept of information technology infrastructure has two relationships even though it has different components; a technical technology information infrastructure and a human technology information infrastructure (Duncan, 1995). Investments in the same information technology infrastructure in one company may result in profitable innovations, but the information technology investment may be less profitable in another company due to the effectiveness of a human technology information infrastructure. This is supported by the research results conducted by Ruiz et al. (2006) which stated that individual and collaborative information technology as well as individual and organizational learning show positive and significant effects on performance. It is also in line with the research results conducted by (Ong & Chen, 2013) which stated that information technology capability has significant effects on company performance in the short and long term.

In addition to the ability of information technology personnel, high company performance is also influenced by information technology investment. This is following the research results conducted by (Ibragimov, 2015) which stated that information technology investment has a strong positive correlation with company performance, in this case, that is measured by the growth of Gross Domestic Product (GDP). Information technology investment is often associated with a company's information technology strategy, whether the company will be an innovator or satisfied to be a defender. The alignment between the information technology strategy and the company's strategy, determine thus a high level of performance will be achieved. This is supported by the research results conducted by (Firman & Said, 2016) stated that information technology strategy has positive and significant effects on company performance directly and by mediating the effects of technology strategy and value creation. Research conducted by (Mithas & Rust, 2016) showed that information technology strategy has an impact on company performance, such as the impact on cost reduction and revenue growth, but this emphasis on performance also depends on the level of company investment (Gueymard, 2017).

Understanding Information Technology Infrastructure

Information technology infrastructure as the basic foundation of information technology capabilities which includes internal techniques (among others: equipment, software and cabling as well as human expertise) that are needed to provide reliable services. According to (Mauerhoefer et al., 2017) information technology infrastructure refers to information technology hardware, communication and data networks as well as information technology employees who are needed to support the distribution of information technology tools. In this study, the information technology infrastructure is represented under the following sub-headings; information technology Capabilities, information technology investment and information technology strategy.

Information Technology Capability

Cepeda & Arias-Pérez (2019) state that information technology capability is an organization's ability to find, implement and developing IT resource and reconfigure IT resources in order to achieve competitive advantage. IT capability is a corporate ability in managing IT resources, where IT capabilities are an important aspect is to achieve business value, business strategies and improving work processes (Cai, 2016). The IT capabilities in this research are the abilities of virtual organizations' leaders to deploy necessary information technology infrastructure so as to effectively drive organizational objectives and overall sustainability.

Information Technology Investment

IT investment can include projects or activities to the development, modernization, enhancement, or maintenance of an IT asset in accordance with their functions and operation as well as with production environment (The IT Law Wiki, 2020). In this project, the IT investment includes all the costs that are incurred by virtual organizations for procurement, development, maintenance of IT assets and IT employee.

Information Technology Strategy

According to Sibanda, & Ramathan (2017) information technology strategy is the actualization of planning, which consists of tactics, principles and goals related to the use of IT in organizations. Alignment of IT strategy with business strategy is essential in achieving performance and overall sustainability. In this study, the IT strategy is the actualization of planning in the use of IT that is aligned with virtual organization's strategy to achieve sustainability.

Dimensions of Information Technology Infrastructure

In this study, information technology infrastructure is addressed under four dimensions which includes; applications, network, database and data ware housing.

Applications

According to techtarget.com applications are software, or programs, consists of all the electronic instructions that tell the computer how to perform a task. The term software was coined by John Tukey. Application software is a set of programs designed for specific uses or applications such as word processing, graphics or spreadsheet analysis. These applications are designed to satisfy a particular need of a particular environment. Application software, designed to satisfy one purpose may not be able to solve other purpose of the same user. For example, software for financial management cannot be used for designing two-dimensional graphics. Similarly, we have word processors for letter writing and presentation software for presentations. We cannot interchange the use of two application software with each other.

Application software can be custom-made but are usually purchased from a software store. Some of the popular application packages are Word processors, Spreadsheets, Database system, Accounting packages, DTP packages, Graphic packages and Antivirus software. Word processing software allows you to create, edit, format, print, and store text material, among other things. Word processor is the most common application software. The well known word processing programs are Microsoft Word, Writer, Wordpad, Text Editor and Star Word. Microsoft Word (MS-Word) is the most popularly used word processing application software that provides you with a number of useful and fabulous features to process the text. A word processor, in general, can be used to manipulate the text in a variety of ways. In addition to it, you can save your documents in a word processor and use them according to the need, whenever required. The features that are provided by any word processor (as editing, formatting text) are available in MS-Word, which also supports some additional and special features (*e.g.*, mail merge).

Techtarget.com posited that word processing is by far the most widely used computer application because it is used for communication, our most common activity. Word processor is used to write, edit and format memos, letters, reports, manuscripts, contracts, and every imaginable type of documents. No matter what the information is or what form it takes, the chances are it was initially composed and written using a word processing program. A word processor is software which provides a graphical user interface with better

capabilities than a text editor does. The main advantage of a word processor is that it provides WYSIWYG (What You See Is What You Get) interface which helps you make changes quickly and easily.

Network

According to Wikipedia (2006) a computer network (network) is a communication network that allows computers to communicate with each other by exchanging data. The purpose of a computer network is to be able to achieve its goals, every part of a computer network can request and provide services (service). The service requester/recipient is referred to as the client (client) and the service provider/sender as the server (server). This model is called a client-server system and is used in almost all computer network applications. Two computers, each with a network card, are then connected by cable or radio as a means of communication and the network operating software forms a simple computer network. If you want to create a computer network with larger dimensions, additional devices such as connection devices are needed, *eg.* For example. hubs, bridges, switches, routers, gateways. The history of computer networks began with the birth of the concept of computer networks in America in the 1940s, which started with the MODEL I computer development project from the Bell Laboratory and a Harvard University research group led by Professor Howard Aiken. Initially, the project wanted to use only one computing device, which had to be shared. To work on many processes without wasting a lot of free time, batch processes were created to allow one computer to run many programs with one queue rule. Then in the 1950s, because the types of computers began to develop through the development of supercomputers, computers had to serve several available locations (terminals).

The development of information science is increasing rapidly, this is evident in the era of the 80s, computer networks are still a mystery that scientists want to answer, and in 1988 they started using computer networks in universities, and in 1988 they started using computer networks. . For businesses now entering the millennium, the global internet in particular has become a daily reality for millions of people around the world. In addition, network hardware and software have changed substantially: at the dawn of development, almost all networks were built with coaxial cable; today many are built with fiber optic or wireless communications. Computer networks allow devices to connect to each other. As an example: Transfer files, share resources, and communicate electronically With the development of computing and communication technology, a single

computer model that performs all organizational computing tasks has now been replaced by separate computers that are interconnected with each other in carrying out their duties. Such a system is called a computer network (Wikipedia, 2006).

Computer networks are built using a combination of hardware and software. When two or more computers communicate or exchange data with each other, a computer network has a part that receives or requests services called a client and a part that provides or sends services is called a server. This type of design is often referred to as a client-server system. This networked computer must also have at least 1 network card, which is then connected via cable or wireless as a data transmission medium and network operating software to form a simple computer network. If you want to create a wider computer network, you need additional devices such as hubs, switches, routers, etc. to support it. There are various types of computer networks that we often see and are classified according to their range, namely:

LAN (local area network)

LAN or Local Area Network is a concept that connects network devices over relatively short distances. Usually used for school buildings, offices, homes, etc. This LAN concept usually uses a special connection, especially Ethernet and Token Ring. There is also a local area network that uses wireless or wireless network technology with WI-FI and is known as a Wireless Local Area Network (WLAN).

1. MAN (Metropolitan Area Network)

MAN or Metropolitan Area Network is a concept that connects network devices from one city to another. Meanwhile, building a network using a local area network is no longer possible, MAN networks are used because their reach is wider than LANs, MANs use special equipment and require telecommunications operators to act as a link between computer networks.

2. WAN (Wide Area Network) WAN or Wide Area Network is a concept that connects computer network devices that cover a very wide area and use very sophisticated equipment. Compared to MAN and LAN networks.

The concept of this network itself is usually used to connect a network from one country to another, ie. H. between countries and even between continents. An example of such a complex device is fiber optics, which are installed underground or under the sea. In the development of computer networks, this cannot be distinguished from the term topology, where topology can be described as the shape or structure of a virtual

network that refers to the arrangement of connected devices, although this shape does not always match (Wikipedia, 2006)

Database

Database systems are any logically coherent collection of data organized for storage and retrieval by computers, as a single, possibly large, repository of data that can be used simultaneously by multi-users (Gehani, 2006). Databases provide a high level of structure for the collection of data. Structured collection of data leads to a consistency that is essential for the operation of an IMS. Data within a database are captured electronically with a relatively small amount of storage space compared with conventional paper records. Databases also allow the use of queries and search tools, which make the retrieval of information from even large amounts of data fast and highly specific.

Berkowitz (1998) posits that the two main types of databases are flat-file and relational databases, in both of which the data are placed in tables with columns and rows. However, in a flat-file database, the data are placed within a single, spreadsheet-like table. In a relational database, each of several tables contains a specific type of information, and the tables are linked by primary and secondary keys. Flat-file databases can be very efficient when there are simple one-to-one relationships between the data (e.g., one patient to one medical record number [MRN]). When the data have one-to-many or many-to-one relationships (e.g., one physician to many patients or vice versa), it is best to use a relational database. Relational databases are preferred to flat-file databases for all but simple applications that are limited in scope.

According to Hawkins, Hugh, Young Scot, Hubert, Katherine, and Hallock (2007), a popular high-level data model used in logical database design is based on the concepts of the Entity-Relationship (ER) model. Currently there is no standard notation for an ER model covering database design for relational DBMSs tending to use one of two conventional notations such as: (i) Chen's notation, consisting of rectangles representing entities and diamonds representing relationships, with lines linking the rectangles and diamonds; (ii) Crow's Feet notation, again consisting of rectangles representing entities and lines between entities representing relationships at the end of a line represents a one-to-many relationship. The database is now such an integral part of our day-to-day life that often we are not aware we are using one. A database application is a computer program that interacts with the database in some way, while database system is a collection of database applications that interacts with the database along with the DBMS and the database itself. Hence, the basic functions of a database are

provided by a DBMS through a database engine; a software system that manages how data is stored and retrieved (Connolly & Carolyn, 2002). For example, Microsoft Jet is a database engine which is a subsystem of Visual Basic and Microsoft Access for stand-alone implementation; while Microsoft SQL Server is for Client - Server implementation. Users interact with the database through a number of database applications that are used to create and maintain the database and to generate information. These programs can be conventional batch applications or, more typically nowadays, online applications. The database applications may be written in a third-generation programming language such as C++ or Java, or in some higher-level fourth-generation language. The physical structure and storage of the data are managed by the DBMS (Date, 2013).

Data Warehousing

According to Abello et al, (2000) the popularity of data warehouses grew fast during the last years. They posited that data warehouse is a subject-oriented, integrated, time-varying, non-volatile collection of data that is used primarily in organizational decision making.” (Auth & Maur, 2002) defined data warehouse as “the huge, silent storage that extracts and then stores the data from the separated transactional system on daily basis. The data warehouse is the decision support database.” From these definitions, we can summarize that a data warehouse collects and stores integrated sets of historical data from multiple operating systems, provides end-user access, enables the knowledge worker to make better decisions or conduct accurate analysis. Thus, the data warehouse is the foundation of Decision Support System (DSS) processing.

According to Rajan (n.d.) data warehouse potential can be magnify if the appropriate data has been collected and stored in a data warehouse. A data warehouse is a relational database management system (RDBMS) designed specifically to meet the needs of transaction processing system. It can be loosely defined as any centralized data repository, which can be queried for business benefit, but this will be more clearly defined later. Data warehouse is a new powerful technique making. It possible to extract archived operational data and overcome inconsistencies between different legacy data formats, as well as integrating data throughout an enterprise, regardless of location, format, or communication requirements it is possible to incorporate additional or expert information it is.

The logical link between what the managers see in their decision Support EIS application and the company's operational activities Johan McIntyre of

SAS institute Inc. In other words the data warehouse provides warehouse provides data that is already transformed and summarized, therefore making it an appropriate environment for the more efficient DSS and EIS applications.

A data warehouse is a collection of corporate information, derived directly from operational system and some external data sources. Its specific purpose is to support business decisions, not business as “What if?” questions. The answer to these questions will ensure your business is proactive, instead of reactive, a necessity in today's information ago (Rajan, n.d.).

He further stressed that industry trend today is moving towards more powerful hardware and software configuration; we now have the ability to process vast volumes of information analytically, which would have been unheard of tenor even five years ago. A business today must we able to use this emerging technology or run the risk if being information under loaded. As you read that correctly - under loaded - the opposite of over loaded. Overloaded means you are to determine what is important. If you are under loaded, you are information deficient. You cannot cope with decision – making expectation because you do not know where you stand. You are missing critical pieces of information required to make informed decisions.

Concept of Sustainability

According to Bestman & Sam (2022), the concept of sustainability has gained and attracted lots of attention in recent times, as organizations with its stakeholders are turning their attention towards this critical issue of sustainability that encompasses the economic, environmental and social dimensions of sustainability. Sustainability of businesses has been gaining its rightful recognition and importance as it offers competitive advantage and creates value for organizations, their stakeholders, and society (Bonini & Gerner, 2011). However, according to (Hong, Roh & Wawski, 2012) sustainability has not been fully integrated at the strategic and operational level. Some researchers believe that the main hurdle in operationalization of sustainability in organizations is the lack of maintainable value creation throughout the value chain, because parts of these activities are beyond the control of organizations, such as supply chain. Others argue that it is the lack of practicable frameworks and models which holds back the organizational actors from (holistically) considering sustainability in business decisions (Nawaz & Koc, 2018). The latter is particularly important because existing sustainability management models and frameworks are based on conceptual and theoretical designs. The structure of these models lacks a fundamental practicable approach which limits their

use in practice. In order to increase the potential application of existing organizational sustainability models, it is important to integrate the sustainability best-practices within the structure of these models. The reason for this is fairly simple: organizational actors generally prefer ‘practical rationale’ over ‘scholarly intellect. Besides applicability, the integration of theories and practices enables the model/framework developers to understand and address the practical limits of organizations in managing sustainability.

Adaptability

Adaptability is the ability of an organization to recognize the need to change and seize opportunities in dynamic environments. In an increasingly complex world, leadership must pay close attention to dynamic, distributed, and contextual aspects in order to position their organizations for adaptability. The theory of dynamic capabilities constitutes a central concept for the requirements that enable organizational adaptability. According to (Uhl-Bien & Arena 2018), Adaptation to changing environmental conditions is a focal subject of organizational studies and deemed a necessity for organizations in every industry. The dynamic nature of most competitive environments requires organizations to continuously or periodically innovate in order to create a competitive advantage and eventually to survive (Hauschildt et al. 2016). Wiltbank et al. (2006) highlighted the significant empirical support for adaptive organizations having higher chances to succeed; in his words, flexible and adaptive organizations are able to outmaneuver their competitors by quickly capturing new opportunities. This can ultimately lead to improvements in the competitive position of an organization and increase the organization’s performance. A central concept capturing the notion of the need for organizations to change is organizational adaptability, which (Birkinshaw & Gibson, 2004) defined as “the ability to move quickly towards new opportunities, to adjust to volatile markets and to avoid complacency”. Among the many theories that were established covering organizational change, a common parameter of all theories is that change is oriented towards a specific individual goal (van de Ven & Poole 2005). Thus, initiating change in an organization is an active decision to achieve a certain outcome, and organizations must create readiness for change. Taking an active decision requires that organizational change should be managed consciously by considering factors that enable change, such as the required knowledge and skills, resources and commitment (Al-Haddad & Kotnour, 2015). In other words, certain capabilities are required in order to successfully manage an organizational change process. The

relevance of adaptability as a measure of the sustainability of virtual organizations cannot be over emphasized. When the goals and objectives of virtual organizations are attained, employees are retained, increased patronage, satisfied clients act as referral agents; undoubtedly, these positive outcomes will ultimately improve the overall productivity and overall sustainability of the firms.

Accessibility

The terms *access* and *accessibility* have been in circulation for at least a century, and their usage generally connotes availability and physical accessibility for a certain population (Guy, 1983). The word *access* in English originated from Latin, meaning “accession” (Hoad, 1996). In contemporary policy discourse in English, however, access is defined as making information and communication technologies (ICTs) widely available to all citizens (Wise, 1997). Echoing this meaning of access, the *Oxford English Dictionary* defines accessibility as “the quality or condition of being accessible (in various senses)” (Oxford University Press, n.d.). It further defines accessible as “capable of being conveniently used or accessed by people with disabilities; of or designating goods, services, or facilities designed to meet the needs of the disabled.” To discuss accessibility, understanding how access, accessibility, and accessible *design* have become common terms (with fluid definitions) in technical communication today is important. This essay will unpack these terms by considering both historical definitions and contemporary perspectives.

Not only do the terms access and accessibility have different meanings, but researchers also differ in how they relate the terms and establish their connection to disability. These differing views represent the perspectives of technical standards organizations, digital rhetoricians, disability activists, and disability studies-centred design scholars. The International Organization for Standardization (2014) defines accessibility as the “extent to which products, systems, services, environments and facilities can be used by people from a population with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of use” (n.p.). James Porter, a digital *rhetoric* scholar, makes a distinction between access and accessibility. “Access,” Porter explains, “is the more general term related to whether a person has the necessary hardware, software, and network connectivity in order to use the Internet—and to whether certain groups of persons have a disadvantaged level of access due to their race, ethnicity, socioeconomic status, gender, age, or other factors” (2009). Accessibility, on the other hand, “refers to the level of connectedness of one particular

group of persons—those with disabilities” (Porter, 2009). Porter also adds that “the reason to write/design for accessibility is not only to allow people with disabilities to consume information, but to help them produce it”. Activists in the disability field do not always make Porter’s distinction. For example, the University of Leeds’ Centre for Disability Studies employs *access* as the search term for all accessibility-related entries on its website. Speaking from a disability studies-centred design perspective, (Sushil Oswal 2013) describes accessibility more broadly as “the ability to use, enjoy, perform, work on, avail of, and participate in a resource, technology, activity, opportunity, or product at an equal or comparable level with others” (n.p.). As these varying definitions from different disciplines suggest, accessibility is shaped by a number of factors which can change from context to context and are both spatial and temporal in nature: physical distance from resources and opportunities, the availability of *technology* and means to overcome that distance, and the infrastructural and legal resources to overcome barriers to workplace entry. For example, for full integration into society, a disabled person not only needs a job to support them self and their family but also laws to protect them from discrimination by employers and providers of services, consistent access to adaptive technology and special training for holding on to a job, accessible opportunities to participate in recreational activities, and of course, availability of inclusively designed consumer goods for living a comfortable life (Wilson & Lewiecki-Wilson, 2001).

Since technical communication is preoccupied with design and communication of information, and since information is imbedded everywhere in human environments, the field’s scope extends into the accessibility of both the brick-and-mortar and digital spaces (Whitehouse, 1999). Accessibility in the former can consist of signage, directories, and spatial maps-digital and otherwise—whereas accessibility in the latter refers to a range of ICTs, including “computer hardware and software, digital broadcast technologies, telecommunications technologies such as mobile phones, as well as electronic information resources such as the world wide web” (Selwyn,

2004). The World Wide Web Consortium’s (W3C) web content accessibility guidelines (2.1) breaks down accessibility into four elements in terms of the interactivity of the web for the disabled user: perceivable, operable, understandable, and robust (Web Accessibility Initiative, 2019). Though W3C’s intent for these guidelines is to assist developers in designing accessible websites from the bottom up, more often, these are used for checking the accessibility of already built websites for the purpose of retrofitting them with accessibility (Wentz et al., 2011).

Methods

This chapter tends to explain and highlight the methods and procedures that will be used for the collection of data to be analyzed in order to achieve the study objectives. This chapter is organized under the following subheadings;

- i. Research Design
- ii. Population of the Study
- iii. Sample/Sampling Technique
- iv. Instrument for Data Collection
- v. Reliability of Instrument
- vi. Validity of Instrument
- vii. Administration of Instrument
- viii. Data Analysis Techniques

Research Design

This empirical study adopted a cross sectional research design which is a form of the quasi experimental research design in its assessment of the study variables.

Population of the Study

The study population was drawn from 12 registered and functional virtual organizations in Port Harcourt, Rivers State. And this information was obtained from the human resources units of each of the organizations under investigation. As a macro study, only management staff of these organizations were studied.

Table 3.1: Names of Virtual Organizations

Names of virtual Organizations		Participants
1.	MTN Nigeria	19
2.	Mobile	16
3.	DSTV Nigeria	12
4.	GOTV	12
5.	Kuda Bank	12
6.	VBank	12
7.	Opay	12
8.	Sparkle	12
9.	PalmPay	12
10.	Fundal	12
11.	Gomoney	12
12.	ALAT	12

Source: Field Survey, 2024

Sample and Sampling Technique

Due to the large nature of the population and our inability to study the entire population, a sample size of 155 was conveniently chosen from the regional offices and branches of 12 functional and operational virtual organizations in Port Harcourt. The sample was arrived at by conveniently choosing managerial staff of virtual organizations in Port Harcourt, since they are in position to give useful and reliable information to the problem under investigation.

Instrument for data Collection

The study utilized structured questionnaire as the instrument for data collection. It contained structured items on the study variables. A five-point rating scale was used and the respondents responded thus;

Very High Extent (VHE)	-	5 Points
High Extent (HE)	-	4 Points
Moderate Extent (ME)	-	3 Points
Low Extent (LE)	-	2 Points

Very Low Extent (VLE) - 1 Point

Validation of the Instrument

This refers to the extent/degree to which an instrument measures what is intended to measure. The researcher employed content validity in the reports to obtain information from the respondents and face validation made by an expert in the field. The data was pre-tested on a group of managers outside our scope of study with a view to ascertaining their suitability for the study.

Reliability of the Study

The test-retest reliability test has the disadvantage of being influenced by patience and memory. The Cronbach's Alpha coefficient aided the researcher in testing the internal reliability of the measures through the Statistical Package for Social Sciences (SPSS). Only items that returned alpha values of 0.7 and above were considered reliable enough for the study.

Table 3.2 Internal Reliability of the instrument

S/No	Variables	Number of items	Number of cases	Cronbach's Alpha
1	Applications	3	136	0.782
2	Networks	3	136	0.702
3	Database	3	136	0.779
4	Data Warehousing	3	136	0.761
5	Adaptability	2	136	0.810
6	Accessibility	2	136	0.726

Source: SPSS OUTPUT, 2024

Administration of Instrument

A total of one hundred and fifty-five (155) questionnaires were administered to the respondents using different online platforms such as their verified social media handles and emails. This was done by the researcher with the help of a research assistant.

Methods of Data Analysis

Descriptive statistic was adopted in the analysis of the properties and demographic coverage while the inferential statistics was used for the test of correlation using the Spearman rank order of correlation coefficient statistical tool. Data analysis

was done using the statistical software for social sciences (SPSS) version 23; with data presentations illustrated using contingency tables and charts.

Analysis and Interpretation of Data

The presentation of the descriptive and inferential analysis of the survey data. The results of this are interpreted to arrive at our study findings. In order to achieve this objective, 155 structured questionnaires copies based on an estimated sample size of the study were administered to leaders of virtual organizations in Port Harcourt, Rivers State. Below is the questionnaire distribution success rate.

Table 4.1: Presentation of Questionnaire Distribution.

<i>Particulars of questionnaire</i>	<i>Frequency</i>	<i>Percentage</i>
Number of questionnaire administered.	155	100
Number of questionnaire retrieved	149	96.13
Number of questionnaire not returned	6	3.87
Number of questionnaire wrongly filled	13	8.72
Number of usable questionnaire	136	91.28

Source: Field Survey, 2024

From table 4.1, it is observed that 155 questionnaires were administered to respondents. 6 questionnaires representing 3.87 percent were not returned. 149 questionnaires representing 96.13 percent were returned. However, out of this number only 136 questionnaires representing 91.28 percent were correctly filled and thus suitable for data analysis.

Data Analysis

The data analysis for this study is categorized into two; descriptive and inferential. The descriptive analysis examines socio-demographic samples and primary data analysis while the inferential analysis examines the test of previous hypothesized statements.

Demographic Analysis

Table 4.2 Showing Sex Distribution of Respondents

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	76	55.9	55.9
	Female	60	44.1	100.0
	Total	136	100.0	

Source: Research Data , 2024 (SPSS output, version 23.0)

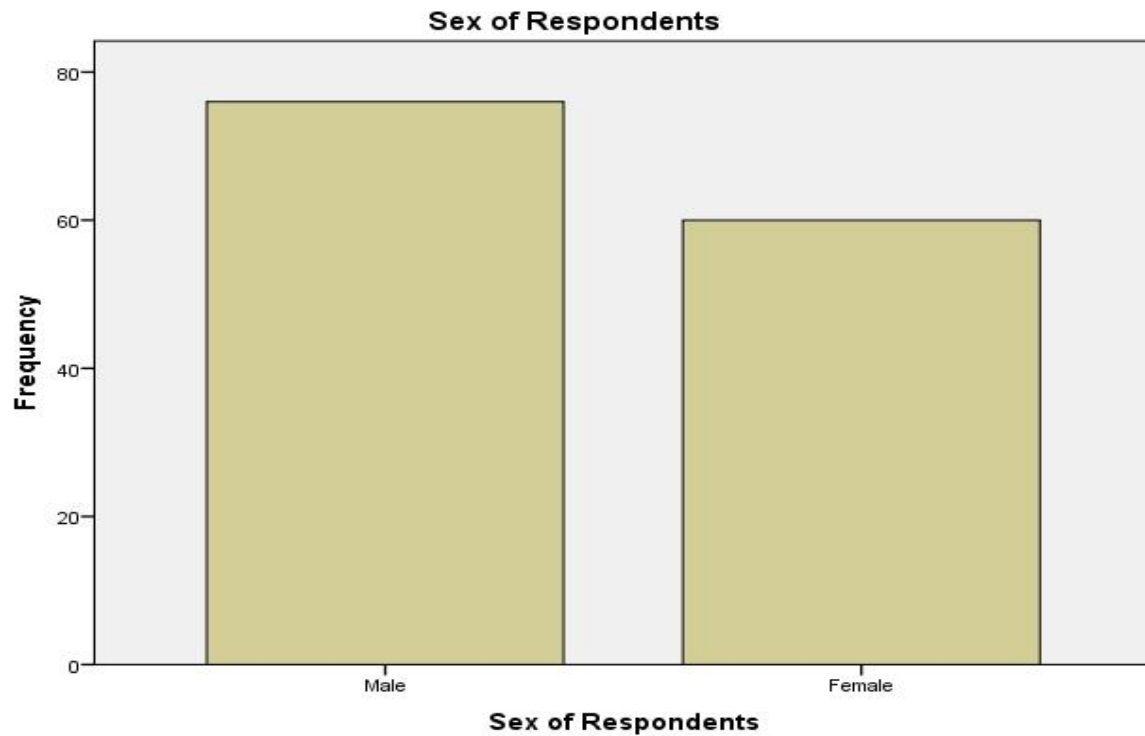
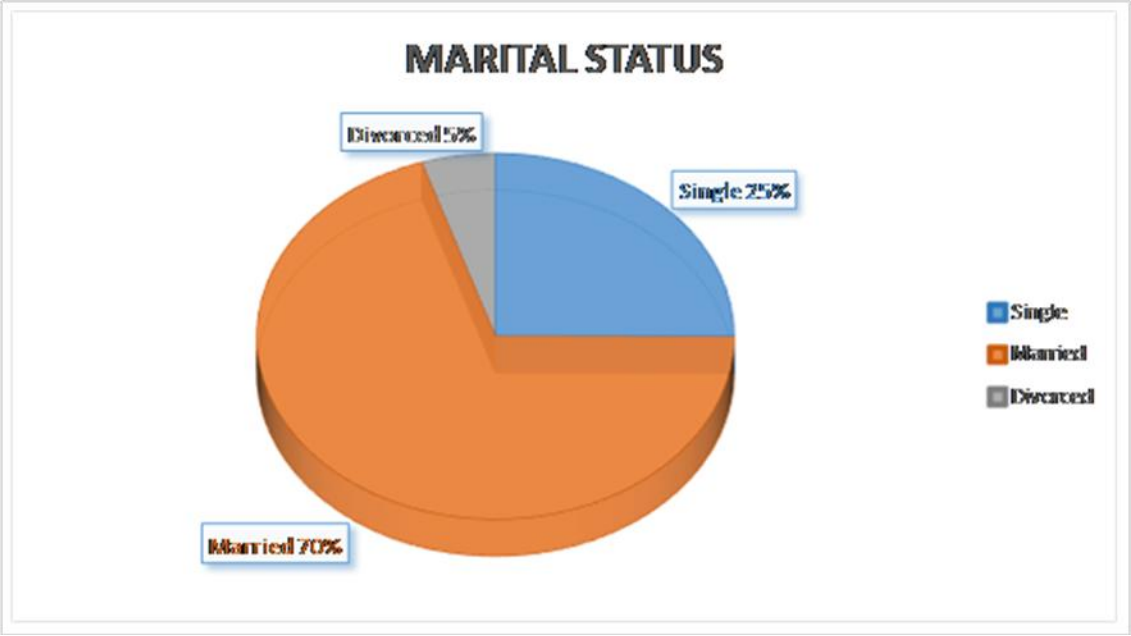


Fig Sex Distribution of Respondents

Table 4.2 shows that 76 (55.9%) of the respondents are males while 60 representing (44.1%) of the respondents are female. Indicating that we had more of males as our respondents

Fig Illustrating Marital Status Distribution

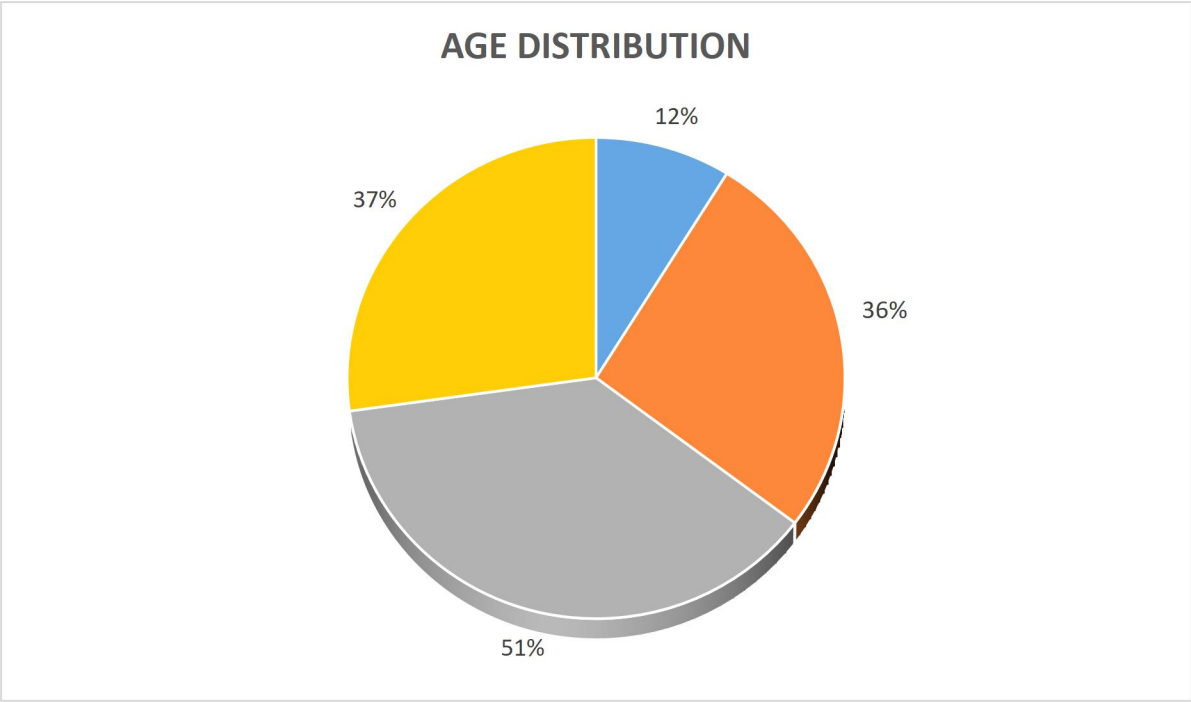
The figure above illustrates the marital status of participants with the proportion of married respondents at 70% more than that of single respondents which stood at 25% and divorced respondents at 5% respectively. This implies that most of the staff in the target population are married.



Showing Age Distribution of Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	30-35 years	12	8.8	8.8	8.8
	36-40 years	36	26.5	26.5	35.3
	45-50 years	51	37.5	37.5	72.8
	51-60 years	37	27.2	27.2	100.0
	Total	136	100.0	100.0	

Source: Research Data, 2024 (SPSS output, version 23.0)



Age Distribution of Respondents

From the data in table 4.3, it can be observed that 12 representing 8.8 percent of the respondents fall within the age bracket of 30-35. Also, 36 respondents representing 26.5 percent fall within the 36-40 years age mark. Furthermore, 51 of the respondents

representing 37.5 percent were observed to have fallen within the 45-50 years age bracket and finally 37 respondents representing 27.2 percent of the total respondents were 55-60 years age bracket.

Table Showing Educational Levels of Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	OND/Diploma	43	31.6	31.6	31.6
	First Degree	39	28.7	28.7	60.3
	Post Graduate Degrees	37	27.2	27.2	87.5
	Professional Certifications	17	12.5	12.5	100.0
	Total	136	100.0	100.0	

Source: Research Data, 2024 (SPSS output, version 23.0)

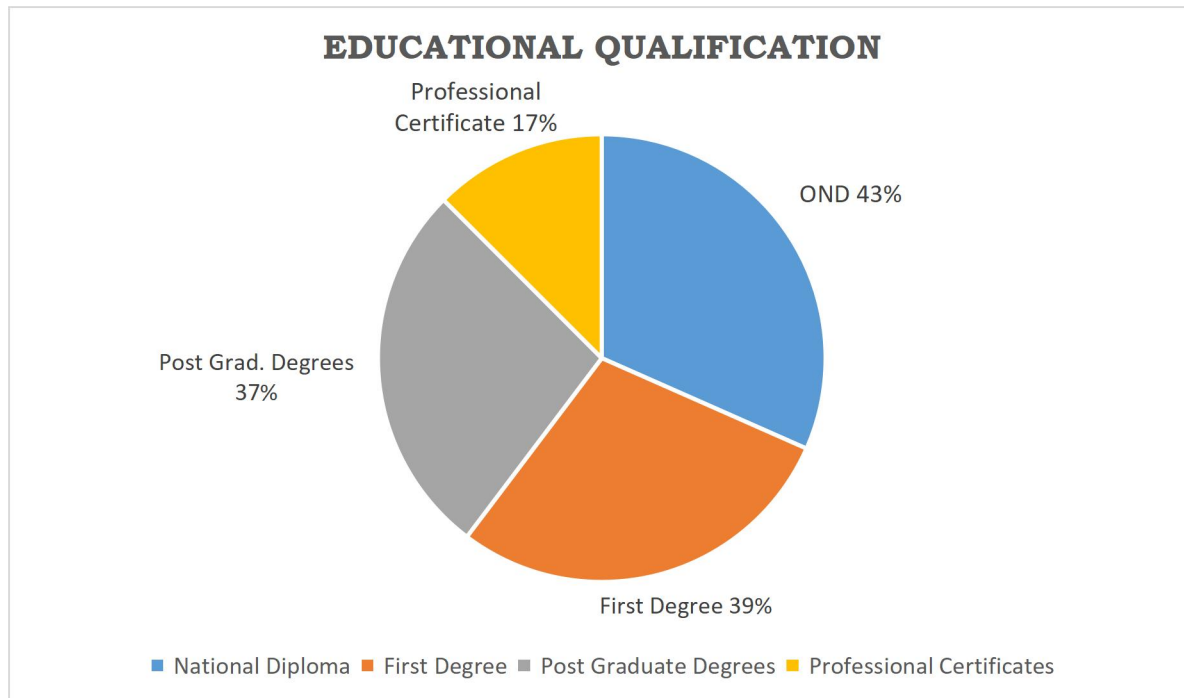


Fig Qualification of Respondents

The data in table 4.4 portrays the educational level and qualification distribution of the respondents. From the results above, 43 respondents indicating 31.6 percent of the respondents were OND/Diploma holders, while 39 respondents representing 28.7 percent were First Degree holders, 37 respondents showing 27.2 percent of the respondents hold post graduate degrees while 17 respondents indicating 12.5 percent are holders of professional certifications.

Primary Data Analysis

The primary data analysis is characterized by frequency of responses mean and standard deviation

score of the responses on the item on the questionnaire and study variables. In this section, analysis was carried out on individual variables and their measures. Mean scores and standard deviations are also illustrated. The independent variable; Information Technology Infrastructure dimensioned into; Applications, Networks, Databases and Data Warehousing is first analyzed and measured on a 3 item instrument and scaled on a 5 point Likert scale (very low extent -1, low extent -2, moderate extent -3, high extent -4 and very high extent -5).

Table 4.3: Showing dimensions of Information Technology Infrastructure

	N	Minimum	Maximum	Mean	Std. Deviation
Applications	136	1.00	4.00	3.83	1.016
Networks	136	1.00	4.00	3.93	.696
Databases	136	1.00	4.00	3.67	.944
Data Warehousing	136	1.00	4.00	3.74	.987
Valid N (listwise)	136				

Source: Research Data, 2024 (SPSS output, version 23.0)

Table above illustrates the descriptive statistics for the dimensions of Information Technology Infrastructure which are applications, networks, databases and data warehousing with a mean score of 3.83, 3.93, 3.67,

3.89 and 3.74 respectively. All four dimensions indicate high response rates based on the adoption of a 5 point Likert scale.

Descriptive Statistics Showing Measures of Sustainability

Source: Research Data , 2024 (SPSS output, version

and scaled on a 5 point Likert scale (very low extent -1, low extent -2, moderate extent -3, high extent -4 and very high extent -5). All measures indicate high

	N	Minimum	Maximum	Mean	Std. Deviation
Adaptability	136	1.00	4.00	4.06	.699
Accessibility	136	1.00	4.00	3.8407	1.00038
Valid N (listwise)	136				

23.0)

Table above illustrates the summary and descriptive statistics for the measures of sustainability which are adaptability and accessibility with mean scores of 4.06 for adaptability and 3.8407 for accessibility. These were analyzed and measured on a 2 item instrument

response rates based on the adoption of a 5 point Likert scale.

Finally, on the descriptive statistic is the analysis of data on study variables. These are Information Technology Infrastructure and Sustainability.

Study Variables

	N	Minimum	Maximum	Mean	Std. Deviation
Information Technology Infrastructure	136	1.00	4.00	3.8324	.72894
Sustainability	136	1.00	4.00	3.9522	.75575
Valid N (listwise)	136				

Source: Research Data, 2024 (SPSS output, version 23.0)

Table 4 illustrates the summary and descriptive statistics for the study variables where information technology infrastructure = 3.8324 and sustainability = 3.9522. All variables have high mean values and agreement rates based on the adoption of a 5 point Likert scale.

Hypotheses Testing

Table 4.5 Test for hypotheses (1)

Adaptability		Applications	Networks	Databases	Data Warehousing
Spearman Rho	Correlation	.562**	.889**	.848**	.876**
Rank Order	Coefficient				
	Sig. (2-tailed)	.000	.009	.012	.014
N		136	136	136	136

Source: SPSS Data output, 2024

Table 4.5 Test for hypotheses (2)

Accessibility		Applications	Networks	Databases	Data Warehousing
Spearman Rho	Correlation	.562**	.899**	.868**	.983**
Rank Order	Coefficient				
	Sig. (2-tailed)	.012	.009	.018	.016
N		136	136	136	136

Source: SPSS Data output, 2024

H₀₁: There is no significant relationship between applications and adaptability of virtual organizations in Port Harcourt, Rivers State.

First Finding: From the result in the table above, the correlation coefficient (rho) shows that there is a significant and positive relationship between applications and adaptability of virtual organizations. The *correlation coefficient* = 0.562 confirms the magnitude and strength of this relationship and it is significant at probability value = 0.000 ($p < 0.05$). The correlation coefficient represents a moderate correlation between the variables. Therefore, we reject the null hypothesis. Decision is based on the $p < 0.05$ coefficient of significance.

H₀₂: There is no significant relationship between applications and accessibility of virtual organizations in Port Harcourt, Rivers State.

This section involves the testing of all previous hypothesized bivariate relationships at a 95% confidence interval implying a significant level of 0.05, acceptance or rejection relative to the p value. The Spearman correlation coefficient statistical tool was adopted in the test for correlations and strength of relations.

Second Finding: There is a significant relationship between applications and accessibility of virtual organizations in Port Harcourt where the *correlation coefficient* of 0.562 confirms the magnitude and strength of this relationship and it is significant at probability value = 0.000 ($p < 0.05$). The correlation coefficient represents a moderate correlation between the variables. Therefore, we reject the null hypothesis. Decision is based on the $p < 0.05$ coefficient of significance.

H₀₃: There is no significant relationship between networks and adaptability of virtual organizations in Port Harcourt, Rivers State.

Third Finding: There is a significant relationship between networks and adaptability of virtual organizations in Port Harcourt where the *correlation coefficient* of 0.889 confirms the magnitude and strength of this relationship and it is significant at

probability value = 0.009 ($p < 0.05$). Therefore, we reject the null hypothesis. Decision is based on the $p < 0.05$ coefficient of significance.

H04: There is no significant relationship between networks and accessibility of virtual organizations in Port Harcourt, Rivers State.

Fourth Finding: There is a significant relationship between networks and accessibility of virtual organizations in Port Harcourt where the *correlation* coefficient of 0.899 confirms the magnitude and strength of this relationship and it is significant at probability value = 0.009 ($p < 0.05$). Therefore, we reject the null hypothesis. Decision is based on the $p < 0.05$ coefficient of significance.

H05: There is no significant relationship between databases and adaptability of virtual organizations in Port Harcourt, Rivers State.

Fifth Finding: There is a significant relationship between databases and adaptability of virtual organizations in Port Harcourt where the *correlation* coefficient of 0.848 confirms the magnitude and strength of this relationship and it is significant at probability value = 0.012 ($p < 0.05$). Therefore, we reject the null hypothesis. Decision is based on the $p < 0.05$ coefficient of significance.

H06: There is no significant relationship between databases and accessibility of virtual organizations in Port Harcourt, Rivers State.

Sixth Finding: There is a significant relationship between database and accessibility of virtual organizations in Port Harcourt where the *correlation* coefficient of 0.868 confirms the magnitude and strength of this relationship and it is significant at probability value = 0.018 ($p < 0.05$). Therefore, we reject the null hypothesis. Decision is based on the $p < 0.05$ coefficient of significance.

H07: There is no significant relationship between data warehousing and adaptability of virtual organizations in Port Harcourt, Rivers State.

7th Finding: There is a significant relationship between data warehousing and adaptability of virtual organizations in Port Harcourt where the *correlation* coefficient of 0.848 confirms the magnitude and strength of this relationship and it is significant at probability value = 0.012 ($p < 0.05$). Therefore, we reject the null hypothesis. Decision is based on the $p < 0.05$ coefficient of significance.

H08: There is no significant relationship between data warehousing and accessibility of virtual organizations in Port Harcourt, Rivers State.

Eight Finding: There is a significant relationship between data warehousing and accessibility of virtual organizations in Port Harcourt where the *correlation* coefficient of 0.868 confirms the magnitude and strength of this relationship and it is significant at probability value = 0.018 ($p < 0.05$). Therefore, we reject the null hypothesis. Decision is based on the $p < 0.05$ coefficient of significance.

Summary, Conclusions and Recommendations

This chapter presents a summary of the findings, conclusions and finally makes recommendations in respect of future study.

Summary of Findings

The aim of this study was to assess the relationship between information technology infrastructure and sustainability of virtual organizations in Port Harcourt, Rivers State. The study was operationalized with the independent variable as information technology infrastructure with the following dimensions: applications, networks, databases and data warehousing, while the dependent variable was sustainability with adaptability and accessibility as measures.

The outcome of the descriptive and inferential analysis revealed the following;

1. There is a moderate and positive relationship between applications and the sustainability of virtual organizations in Port Harcourt, Rivers State.
2. There is a moderate and positive relationship between networks and the sustainability of virtual organizations in Port Harcourt, Rivers State.
3. There is a significant relationship between database and the sustainability of virtual organizations in Port Harcourt, Rivers State.
4. There is a significant relationship between data warehousing and the sustainability of virtual organizations in Port Harcourt, Rivers State.

Conclusions

The study concludes that information technology infrastructure positively enhances the sustainability of virtual organizations in Rivers State. In line with the specific objectives the following conclusions emerged: Applications moderately enhance the sustainability of virtual organizations in Rivers State, Nigeria. Also, network positively enhances the sustainability of virtual organizations in Rivers State. Again, databases positively enhance the sustainability of virtual organizations in Rivers State. Furthermore, data warehousing positively enhances the sustainability of virtual organizations in Rivers State.

Recommendations

1. Management of virtual organization in Rivers State should implement the utilization of relevant applications in order to enhance the sustainability of virtual organizations.
2. Leaders of virtual organizations should invest heavily on the acquisition of networks so as to drive the sustainability of virtual organizations.
3. Management of virtual organizations should integrate their databases in order to enhance administrative efficiency of virtual organizations in Rivers State.
4. They are also encouraged to adopt data warehousing as a strategy for reporting and presentation, so as to make smarter and intelligent business decision

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